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Methane to Gasoline

New Zealand plant meets expectations Page 22

Textile finishing chemicals face solid growth Page 9

CALENDAR OF EVENTS
Scientific meetings Page 28

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NEWS

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JUNE 22, 1987

News of the Week

■ **Battle over the patenting of new, genetically engineered animal life forms heats up.** **Page 4**

■ **Margaret Thatcher's re-election as Britain's prime minister doesn't bode well for U.K. science, already hard-pressed for financial support.** **Page 5**

■ **Imperial Chemical Industries, with its acquisition of Belgium-based European Seeds Co., moves forward aggressively into worldwide seeds business.** **Page 5**

■ **"Loyalty contracts" between an individual chemical shipper and an individual ocean common carrier will not be challenged by the Justice Department.** **Page 6**

■ **Monsanto seeks EPA permission to field test a system that tracks distribution of genetically engineered microorganisms in soil.** **Page 6**

Business

Textile finishing chemicals, which are supplied by a large number of dynamic small- and medium-sized companies, represent a $330 million, steady-growth market. **Page 9**

Government

Several bills being considered by Congress would provide specific funding for academic research facilities—a move that is generally viewed favorably by both legislators and researchers. **Page 18**

Science

Doped polyacetylene, with copperlike conductivity at room temperature and remarkable stability, is synthesized by BASF chemists. **Page 20**

Proposals to carry out contract projects relating to preparation of compounds for investigation or use against AIDS are sought by the National Cancer Institute. **Page 21**

Meetings

C&EN's semiannual calendar lists meetings and other events of interest to chemists and chemical engineers. **Page 28**

Cover: New Zealand Synthetic Fuels Corp. methane-to-gasoline plant at Motunui

Technology

World's first methane-to-gasoline plant, which has been operating for just over a year in New Zealand, has met its strategic goal of reducing New Zealand's dependence on foreign oil. **Page 22**

Letters 2

Concentrates

Business 7
Government 17
Science/Technology 19

The Departments

ACS News 26
Newscripts 48

Textile Finishing Chemicals: Slow but Steady Growth Ahead

Market for these chemicals, supplied by number of feisty small- and medium-sized firms, amounts to $330 million and is growing 5% annually

Marc S. Reisch, C&EN New York

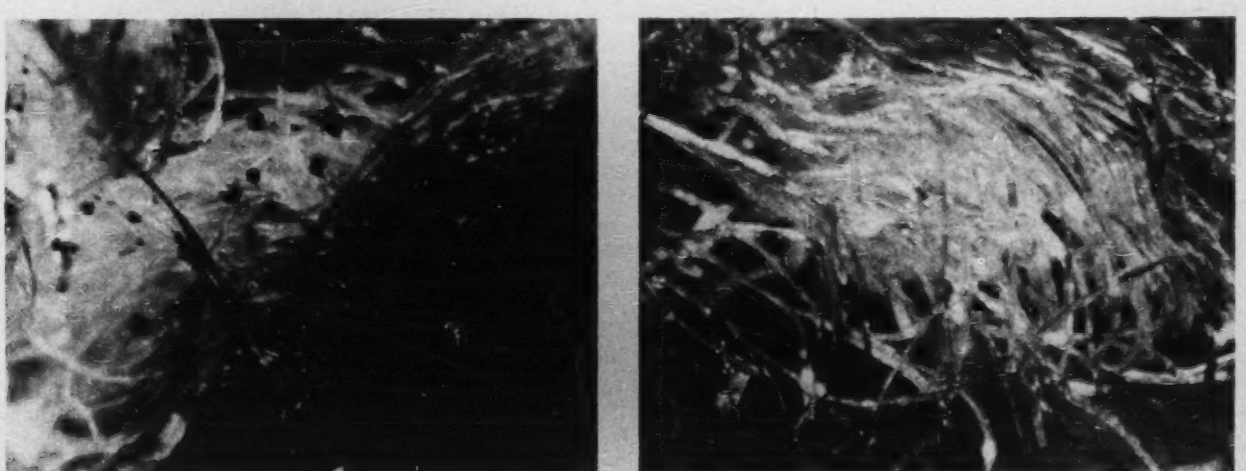
The textile chemical industry has been buffeted by the same ill wind affecting its mill customers: Foreign suppliers of finished fabric, apparel, home furnishings, and industrial textiles have been taking an increasingly larger share of the U.S. market.

The import problem is only a part of mill and textile chemical producers' woes. The textiles business is already a complex one. Mills and chemical producers, particularly of finishing chemicals, have to balance, on the one hand, the demand for products to suit fashions of the moment in apparel and home furnishings, and, on the other hand, environmental worries such as formaldehyde in resin-cured, permanent-press finishes that is believed to pose a health threat to textile cutting room operators.

The U.S. textiles business, however, is not moribund. Although some huge textile mills, such as Milliken and Burlington Industries, operate along with large chemical suppliers, such as Du Pont and Dow Corning, the industry is basically characterized by a large number of feisty small- and medium-sized textile and chemical firms. Their specialty products or chemical formulations give them a small piece of the action in a sometimes frantic but always energetic textile industry. According to the July 1986 Textile Chemist & Colorist Buyer's Guide, 168 firms supply textile finishing chemicals.

The U.S. textiles market is huge—worth, according to industry estimates, more than $50 billion in annual sales. The American Textile Manufacturers Institute (ATMI) estimates last year's U.S. market volume at 35.7 billion square-yard equivalents, based on U.S. government figures. Of that number, 23 billion square-yard equivalents was produced in the U.S., and the remainder, or about 36%, was imported. In apparel alone, imports of finished apparel and finished fabrics took 52% of the U.S. market. Overall, according to ATMI, imported fabrics have grown at an annual average rate of 24% over the past five years.

The textile chemical industry has not fared quite so badly and has experienced modest growth. According to Steve R. Daigle, project manager for industry consultant Charles H. Kline & Co., the entire market for textile wet processing chemicals was worth some $675 million in 1986. Surface finishing chemicals, the value-added components—which affect fabric performance and which consumers can feel, sometimes see, and base a buying decision on—were worth about half that amount, or $330 million. Those surface finishing chemicals include a huge number of easy-care resins, water- and soil-repellent finishes, hand modifiers and softeners, flame re-



Microscopic view of carpet fiber samples shows fungus control properties of antimicrobials such as Dow Corning's Sylgard. Untreated sample (left) shows no resistance to fungus growth; sample on right was treated with antimicrobial

New generation of soil and stain protectors enters broadloom market

Consumers have been able to shop retail outlets for soil- and stain-resistant nylon carpet for a number of years now. Recent improvements in finishing technology, however, have led consumers to expect a new level of "easy-care" performance in residential carpet. Fiber producers, finish suppliers, and carpet retailers all hope to reap the benefits of this market expansion.

At the forefront promoting new finishing technology for the $9 billion a-year residential carpet business are primary nylon fiber producers Du Pont, Allied-Signal, and Monsanto. In quick succession in fall 1986, Du Pont introduced Stainmaster-certified carpets, Allied-Signal followed with Anso V, and Monsanto introduced its gold and silver label wear-dated nylon broadloom.

All the fiber producers began with previous state-of-the-art fluorochemistry as a component specified in their certification programs to label the new generation carpeting produced by broadloom mills. But each chose a different approach to provide the ultimate consumer with carpeting from which tomato juice or a children's popular red soft drink could be washed out even after the initial spill had dried.

Du Pont's Stainmaster carpet has three basic components, says K. Bruce Koepcke, carpet fibers division market manager. The first is top grade nylon fiber, second, improved Teflon fluorochemical treatment for durable dry soil resistance, and third, the new Stainmaster component, a proprietary polymer treatment of the dyed carpet fiber that "closes the leftover dye sites and makes them no longer available for staining," says Koepcke.

The Du Pont manager says only that the Stainmaster proprietary polymer is of a "class of materials used as dye resists in the past." The polymer is applied to the carpet after tufting and during the finishing process.

He believes that ultimately the market for the latest generation nylon carpets could capture 70% of the residential carpet business. In doing so, it certainly would expand the market for Du Pont's nylon carpet fibers and "increase dollar volume of the market," he says.

Allied-Signal's Anso V carpet system starts with the firm's fluorochemical-treated Anso IV nylon fiber. A stain-resistant polymer is added to the carpet by the mill and the resultant carpet must pass stringent certification standards.

Mills that use Monsanto's fiber and certification labels have two options. They may add a polymer treatment to the silver label carpet in the finishing stage for enhanced soil and stain resistance, or they may opt for the gold label treatment. According to R. J. Snooks, Monsanto's manager of nylon product development, the treatment for nylon fiber destined for the gold label carpet is applied to the nylon fiber in the dry-spinning stage prior to the fiber-drawing process when the fiber is at 280 °C.

The stain-resistant agent is a low-molecular-weight sulfonated phenolic resin. When the fiber is drawn, the stain-resistant agent is locked into the fiber itself, Snooks says. Dyeing of carpet fiber can occur after treatment by applying heated dye to the fiber. The dye sites do not accept color at the temperature of most household liquids, thus allowing easy cleanup of potentially staining spills even after they have dried.

Like his competitors in the fibers business, Snooks sees an increase in both production and sales of high-value, higher-priced carpet. "I think there is potential here to see significant poundage of our fiber sold on the market," he says.

3M, which is not itself a nylon fiber producer but is a major branded textile fluorochemical treatment supplier, also is seeking a piece of the action of fifth-generation nylon carpeting. According to Tom G. Gerlach, marketing communications manager of the protective chemicals division, 3M is introducing Scotchgard stain release for carpeting. 3M has programs in place with large carpet mills such as Shaw and Coronet and plans to introduce branded programs on the retail market.

tardants, and a host of specialty antistatic compounds and biocides.

Textiles, says Daigle, are "not a dynamic growth category." But, he adds, the consulting firm believes textile chemicals have not done too badly because a lot of business that left the U.S. was for the less expensive commodity textiles. Textile specialty chemicals are more in use for more expensive fabrics. As a result, specialty textile chemical sales have been growing at a rate of about 5% a year, a little higher than growth of gross national product.

Industry consultant Ed Hochberg concurs on the growth trends for textile chemicals. He sees a trend in the industry to greater emphasis on industrial and home furnishings textiles, including broadloom, for which competition from the Far East is minimal. Chemical applications likely will follow that trend, he points out.

Textile finishing chemicals make a large contribution to the final textile product, according to Martin Tambor, textile technical manager for National Starch & Chemical. "Chemicals are cheaper than fibers," he says. "In many cases 10% or more of the weight of a textile comes from chemicals. Durable-press resins alone can account for 8% of a fabric's weight."

National Starch's textile chemicals group is a major producer of durable-press resins used on all cotton and blends of cotton with man-made fibers such as polyester. In addition, National Starch produces and markets a line of polyolefin and organic nitrogen-containing cationic softeners as well as a line of silicone softeners. Tambor says that National Starch's polymer group, which formerly was Procter Chemical, formulates and synthesizes its own blend of proprietary products. Textile chemical businesses, he adds, "tend to do less than $15 million in business annually mostly because they are small, highly responsive concerns in a competitive business where short response time to mill customer requirements is important."

Many of those textile companies are now working to bring to the

market low-formaldehyde or no-formaldehyde durable-press resins because of concern that possible exposure to formaldehyde fumes may pose a health risk to workers in cut-and-sew operations. Tambor says that National Starch has just introduced a no-formaldehyde, glyoxal-based, durable-press resin called Protorez. "It is priced at a premium compared with low-formaldehyde resins. The problem is that no one can come up with a cheap substitute for urea formaldehyde."

National Starch also is working on durable-press polymers that may allow completed garments to be dyed after the polymer has been applied. Consequently, the company hopes to take part in an industry trend that promises to provide garments in a given size and color in 10 days instead of the six to 10 weeks it now takes, Tambor says.

Sequa Chemicals, formerly Sun Chemical, also is a major supplier of permanent-press resins to the textile industry. Sequa is ready for an industry switch to low-formaldehyde or no-formaldehyde, permanent-press resins when the industry is ready for it. According to Sequa general manager Jack Cabrey, Sequa pioneered glyoxal-based resins and indeed invented permanent-press technology. Sequa's new Permafresh low-formaldehyde and no-formaldehyde formulations "perform as well as a urea formaldehyde resin, but cost is at a premium. Although the per-garment cost is small, the cost of these resins can be as much as five to six times that of the urea formaldehyde resins," Cabrey says.

Sequa considers itself a one-stop shop for textile chemicals. According to Cabrey, the company also formulates and sells a line of hydrophobic thermosetting resins and zirconium synthetic wax water repellents, polyethylene emulsion and fatty glyceride softeners, as well as flame retardants and soil repellents.

Another one-stop shop for textile chemicals is the Chem-Mark division of Ivaco, which, according to its president George D. Maynard Jr., has an annual sales volume of $8 million. Like many of its competitors with broad-based lines (Maynard estimates there are 30 such competitors), Chem-Mark formulates and sells durable-press resins such as its Reactex glyoxal resins. Other products include Chemweld, which keeps loose-knit fabrics from slipping and imparts a soft feel to the fabric.

Maynard agrees that the textile chemical business is a rough-and-tumble one. "Everyone of us has five to 50 unique products and 100 to 150 products that everyone else has." It's an industry that requires so many suppliers, in part, because companies have to be relatively small and agile to service very demanding fabric mills, each of which seems to require products tuned precisely to its specific needs, he says.

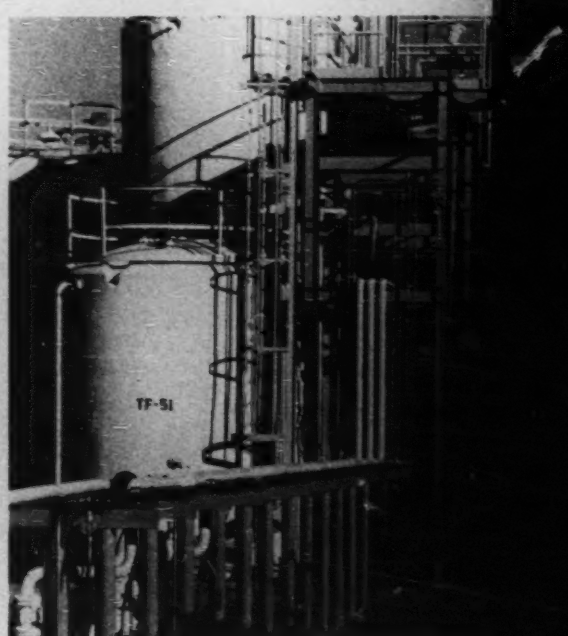
Chemical companies need not always have an extensive line of products to have a presence in the textile finishing area. Angus Chemical manufactures a line of permanent-press resin catalysts that aid in the curing of those resins. One, an amino hydroxy compound called DMAMP-80, which is 2-dimethylamino-2-methyl-1-propanol, is a slow-cure aid for easy-care resins that helps preserve fabric strength and does not tend to yellow light-colored fabrics, according to Bob Purcell, Angus product development director. The company, a specialist in the nitration of propane, also sells a faster-acting resin catalyst, amino methyl propanol.

American Cyanamid is another company with a large variety of textile chemicals and a major force in permanent-press resins. The company has a captive domestic source of glyoxal; it produces the compound at its Charlotte, N.C., plant. According to Les Reynolds, American Cyanamid's manager of textile chemical business development, growth has slowed in durable press. It is a competitive business, he says, and at times the cost of new developments has limited profitability in the business. "Everybody spent a fortune developing nonformaldehyde resins. Basically, there is no cheap replacement for dimethylol dihydroxy ethylene urea resins," says Reynolds.

Because of the concern with formaldehyde fumes, Reynolds says that Cyanamid has seen a "shift in our market to where the largest percentage of resins we sell contain glyoxals." Cyanamid sells a number of melamine and urea formulations as well.

In addition, Cyanamid sells a small line of softeners based on polyethylene emulsions, fatty acid ester blends, and silicones for use with its extensive durable-press resins line, and it has a line of water repellents and fluorochemical water-, oil-, and stain-repellent extenders. The company has re-entered the flame retardant business "after a hiatus," says Reynolds. Applied by a half-dozen small specialty finishers for industrial and military use on cotton shirts and pants, its Aerotex line of phosphine-based flame retardants show some growth potential.

Hoechst Celanese is also an important supplier of easy-care resins for textile finishing. Like Cyanamid, it, too, is basic in glyoxal, which is supplied from a Hoechst plant in France. According to Martin G. Doeleman, textile chemicals market manager for Hoechst Celanese, "We make Casurit easy-care resins and supply glyoxal to resin formulators, too. Our main objective is to be a supplier of raw material to resin manufacturers."



Sequa Chemicals' Chester, S.C., plant supplies permanent-press resins

Research now is aimed at developing faster-cure, easy-care resins to save energy and money, Doeleman says. Whereas many fabrics may have to cure now for three minutes at 300 °F, Hoechst Celanese is trying to develop resins that might cure for one minute at the same temperature, he says. Hoechst Celanese also makes a line of silicone-based softeners, and fatty acid esters also used for softening.

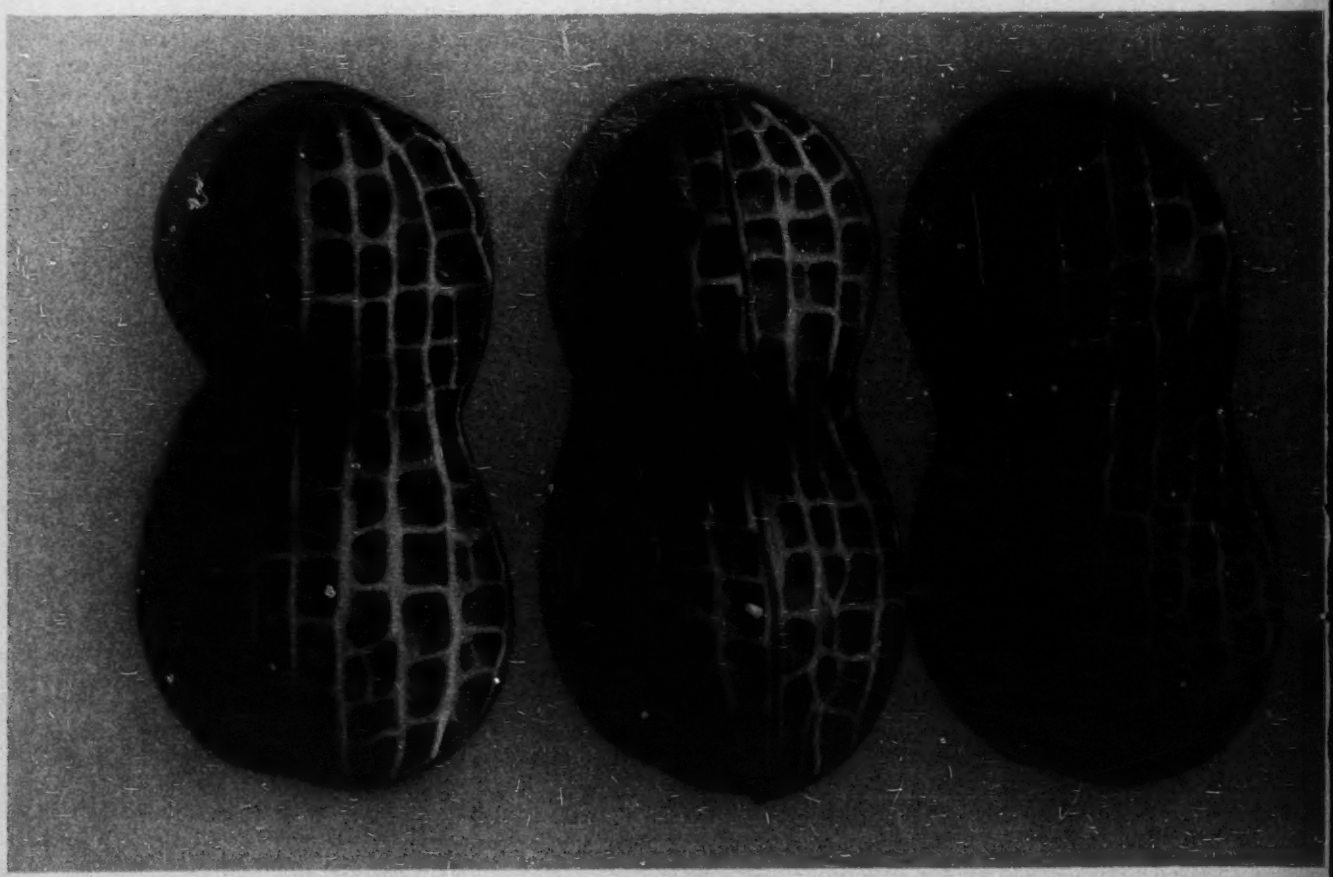
In addition, Hoechst Celanese is involved in a line of business—water-, soil-, and stain-repellent fluorochemicals—that is very different from the durable-press resins and softeners market. Fluorochemicals with labels such as Scotchgard from 3M and Teflon and Zepel from Du Pont are well-recognized consumer labels that compete in apparel and broadloom with Hoechst Celanese's unbranded monomer. "We supply the monomer to formulators who blend unbranded products. Their products are more attractively priced because they lack a label and the overhead it demands," Doeleman says. Supplying both solvent and emulsion type fluorochemicals, Hoechst Celanese, like 3M and Du Pont, is basic in fluorochemical production, he says.

Success in the well-known brandnames is a matter of "getting the end user to specify our product," says Tom G. Gerlach, 3M's protective chemicals division marketing communications manager. It is a type of chemistry that gives obvious added value to textiles, he says, and one that the textiles consumer would be willing to pay for when he or she sees the Scotchgard tag on merchandise. 3M requires strict adherence to high-performance standards before textiles are allowed to display the Scotchgard name.

In like manner, Du Pont puts its marketing muscle behind its Teflon home fashion and Zepel apparel rain- and stain-repellent fluorochemical products. It, too, enforces performance requirements on products carrying its labels. Advances have allowed Du Pont to develop a fluorochemical formula that will work on woolen apparel fabrics, according to John Thackrah, business manager in Du Pont's chemical and pigments department.

Du Pont creates demand for its fluorochemicals by going directly to consumers and retailers with the romance of easier care. "You can't see, smell, or touch what it does," says Du Pont merchandising and business services manager Richard Moody, "but it does cause water-based and oil-based stains to bead up so that you can blot them off before they stain a fabric." And, adds Thackrah, that "adds peace of mind to living."

Also supplying fluorochemical products to the U.S. market through a business linkup with a Japanese resource is ICI Americas, part of the U.K.'s Imperial Chemical Industries. According to Christopher A. Fergu-



Easy-care resins lead textile finishing chemicals

$ Millions	1986 sales
Easy-care resins	$120
Water-, oil-, and soil-repellent finishes	90
Hand modifiers and softeners	70
Flame retardants	35
Other finishes[a]	15
TOTAL	$330

a Includes antistatic compounds, mildewcides, germicides, and mothproof agents. Source: Charles H. Kline & Co.

son, business manager of specialty finishes, "our fluorochemical endeavors are technological rather than merchandising." He claims ICI Americas' Milease F-14 for mainstream use and Milease F-31X for rain, ski, and outdoor wear are more durable to repeated drycleaning, and are "better mouse traps," than products from the company's other well-known competitors.

One of the small agile formulators of fluorochemical treatments for textile mills is Lindley Chemical, which, according to Thomas Lindley Jr., is widely known in the hosiery and piece goods treatment business. "We procure the fluorinated monomer and proceed from that point. Our specialty is to process the monomer to the final polymer or emulsion depending on the application method," Lindley says. The company also formulates a number of silicone softeners by processing the silicones to produce unique products, such as a silicone for foam application.

For textile softening chemicals, Union Carbide is one of the larger companies involved. According to Terry L. Lance, textiles business manager within the specialty chemicals division, "Formulators take our product and may blend it with polyethylene and fatty acid softeners. We don't blend softeners, but we sell softeners to formulators who will mix specialties to help a mill get a special effect."

Carbide does refine its silicones, thereby producing products ideal for different market segments. One new product, MagnaSoft TLC, is a silicone softener designed primarily for disposable nonwoven fabrics. For instance, it makes the polypropylene fiber frequently used in diaper cover stock hydrophilic as well as softer, Lance says. Another recent product, MagnaSoft Extra, is based on new patented silicone technology, he says, and is a completely nonyellowing "super softener" aimed primarily at cotton-rich products recently popular with consumers.

In the trendy fashion fabric business, "niching products to smaller applications areas is our defense. There is not just one application for our silicone products," Lance says. Carbide is also a supplier of Carbowax polyethylene softeners to formulators, but it is a business one

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Carbide spokesman characterizes as a "commodity area" that moves on price.

Du Pont's Avitone A softener is a sodium hydroxide softener that Horn characterizes as an excellent anionic softener for cotton and cotton-blend fabrics. Avitex NAR is a higher alkyl amine softener for use on fabrics composed entirely of synthetic fibers. "These products don't replace silicones or polyethylene," says Horn. "They give a different hand and lubricity than the others." For instance, Avitone A provides a desirable feel, particularly to cotton terry cloth, he adds.

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Formulators that combine ingredients to form fabric finishes include specialists such as Burlington Chemical (which is not associated with the huge fabric mill Burlington Industries). According to Sam B. Moore, vice president of research and development, Burlington Chemical makes a number of fatty acid-based softeners as well as polyethylene and silicone softeners. A challenge for the company now is to come up with finishing formulations, particularly softeners, that will allow garment manufacturers to dye garments after they are cut and sewn. Such a technological success would enable manufacturers to hold down inventories while still delivering garments more quickly to retail outlets in the colors most in demand.

Another formulator of softeners is Sandoz, best known as a powerhouse in the textile-dyeing business. Its softeners include a silicone elastomer finish, Sandoperm FE, that is blended with a catalyst and crosslinker for a smooth elastic finish on knit fabrics. A hydrophilic silicone softener, Silsmooth VEL, offers more comfort in cotton and cotton-blend fabrics, and cationic fatty acid softeners, Ceranine HCA for cotton and Ceranine PNL for synthetics, offer the unique soft hand and bulk of cationics and contribute minimally to the yellowing of fabrics, the company says.

Another basic silicone supplier who keeps a close eye on the textiles market is Dow Corning. It markets a line of products that formulators buy and tailor to an individual mill's requirements, according to Richard W. Awe, associate development scientist for Dow Corning. It also supplies an emulsion silicone formulation for softening, Dow Corning SSW emulsion, which a mill can apply directly in finishing.

An advantage of the silicone softeners is that they make fabric woven from coarse yarn spun on new, highly efficient open-end spinning equipment more acceptable, Awe says. And though silicone softeners are premium-priced softeners that produce "much smoother and softer fabrics than polyethylene-treated fabrics," their cost may be justified on new fabrics woven of open-end spun yarns, he says.

In addition, Dow Corning markets antimicrobial agents for socks, hosiery, carpet, and nonwovens also based on silicone technology. The company is one of the better-known suppliers of antimicrobial agents, sold under the Sylgard trademark, Awe claims.

An equally known, if not better-known, supplier of antimicrobial textile treatments is Sanitized. The company is headed by Stewart E. Klein, a micropaleontologist whose knowledge of chemistry and interest in a 50-year-old family business selling antimicrobial textile treatments led to his most recent discovery of an antimicrobial agent composed of certain silyl quaternary ammonium salts. His patent on these salts is one of many Sanitized holds, Klein says.

Products of Sanitized are distributed in the U.S. by Sandoz. A key to the success of the company, according to Klein, is its large-scale, quality-control testing of fabrics incorporating Sanitized products by independent laboratories. That, together with efforts to convince mass

merchants to specify Sanitized products, is another important element in the company's marketing success, he says.

Interest in the consumer market in cotton-rich and all-cotton fabrics has led to increased institutional interest in cotton for uniforms in hotels, motels, and hospitals as well as in the defense industry. Fabrics for institutional use must be flame retardant. Albright & Wilson, a U.K.-based company with U.S. operations owned by Tenneco, sells a phosphonium-type flame-retardant material to treat 100% cotton chambray shirts, denim pants, and workwear, according to Glenn W. Holden, product manager. Its formulation is sold under the names Proban and Retardol.

Another flame retardant, Antiblaze, treats 100% polyester and nylon drapery, window shades, and curtains for institutional use with a phosphorus-based material, says Holden. He sees growth in flame retardant treatments propelled mostly by legislation in several states that require flame-retardant textiles, particularly in public places.

White Chemical, which emphasizes bromine-based flame retardants, aims its products at upholstery and automotive finishes as well as heavy industrial protective clothing. According to Charles E. White, flame retardant marketing manager, 5-oz-weight shirting fabrics treated with White's compounds withstand a molten aluminum splash and will not burn the person wearing the fabric because the treated fabric will not transfer heat.

"We're not trying to sell a drum of soapy water," emphasizes White, explaining the complexity of the textile chemical business in general and the technological attention and support required of his company's flame-retardant chemicals in particular. There are, he says, "a lot of specialized system applications in the textile business." □

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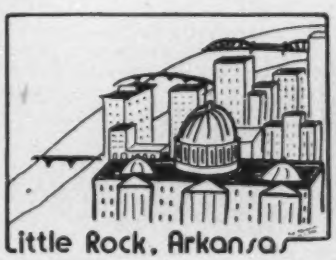

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